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Backgrounder

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The Canadian Dollar: Still a Commodity Currency

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Despite the recent increase in the value of the Canadian dollar relative to the US dollar, many still view it as deeply undervalued. Yet, while the Canadian dollar has fallen in value against some currencies, it has appreciated against others. A close look at the determinants of the Canadian/US dollar exchange rate over the 1973–2000 period, based on a commonly used model developed at the Bank of Canada, suggests two main conclusions. First, the Canadian dollar remains a commodity-based currency, its value being explained reasonably well by movements in commodity prices. Second, the value of the dollar is just about where that model says it should be. According to the model, there is no need for policy intervention that attempts to increase its value relative to the US dollar.

Canada's exchange rate is a source of continuing controversy. Some analysts hold up the Canadian dollar's decline against the US dollar as a sign of a deeper economic malaise and, as a solution, suggest fixing the exchange rate on the US dollar, pursuing a common currency arrangement for North America, or even adopting the US dollar outright. Even among those who seem willing to persevere with a flexible exchange rate regime, there is still concern about the currency's current value.[1] Surprisingly, perhaps, these issues were not debated during the recent election campaign, but we suspect that overtly political debate about the currency will recommence before long.

1 See, for example, "Outlook 2001 Supplement," *National Post*, January 2, 2001. Richard Harris, a member of that newspaper's panel of economists, advises the new governor of the Bank of Canada to fix the exchange rate at 75 US cents. Michael Walker, another panelist, urges the new governor to take seriously Herbert Grubel's proposals for a North American currency union based on a new currency he calls the "amero," while panelist Sherry Cooper suggests the governor issue a statement on the importance of a strong currency. Near the end of last year, some commentators (for example, Rubin et al. 2000) were forecasting that the dollar was about to depreciate to 60 US cents.

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It is impossible to create prosperity through manipulations of the exchange rate, including fixing it irrevocably.

Long ago, economists learned, or should have learned, that it is impossible for a country to create prosperity by devaluing its currency. It is high time that economists also understood that it is equally impossible to create prosperity through other manipulations of the exchange rate, including fixing it irrevocably. Currently fashionable notions that, under a fixed exchange rate regime, Canada's productivity performance would improve are just conjectures, and no better founded than was the once-popular belief that devaluation would create export-led growth.

Economic prosperity and decline always result from deeper forces than exchange rate arrangements. To the extent that purely economic arguments are relevant to the choice of a particular regime, they should address the ways in which alternative arrangements help or hinder the economy to adjust to those deeper forces and policymakers to address the problems and opportunities those forces present.

This *Backgrounder* presents results in support of looking at the policy problem in this way. First we show that the Canadian dollar's behavior has been neither spectacularly "good" nor "bad" over the past five years, compared with a broader array of currencies than just the US dollar. We then turn to the Canadian/US dollar exchange rate and present some results of our own work on what determines its value.[2] This work suggests that, in addition to the effects of inflation differentials between Canada and the United States on the nominal exchange rate — a factor that, in any event, should have helped the Canadian dollar to appreciate slightly in the 1990s — world non- energy commodity prices have dominated the real exchange rate's long term behavior.

Our main finding is that the evidence supporting the importance of these prices remains extremely robust, although, as the reader will see, our results raise doubts about previously held beliefs about the effects of energy prices on the exchange rate. Our results, then, imply that, because Canada remains an important commodity exporter, the Canadian dollar remains very much a commodity currency. When commodity prices fall, as they have on average since 1995, Canadian living standards must fall. The exchange rate on the US dollar is the messenger that brings this news, not the cause of the problem. Furthermore, while changes in the Canadian-US short-term interest rate differential may give the dollar some support, no dramatic appreciation will occur unless commodity prices rise significantly — an unlikely eventuality for the near future, given that the US economy seems to be slowing down and Japan's sluggishness continues to keep the brakes on Asian economic performance. At the same time, however, our results also imply that exchange rate movements will continue to help absorb the shocks that commodity price fluctuations impart to the Canadian economy as long as Canada remains an important commodity exporter.

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2 This work builds on what has come to be called the "Bank of Canada" equation, a relationship on which most, but not all, past C.D. Howe Institute studies have relied to explain the exchange rate's decline. See, for example, Laidler (1999); Laidler and Poschmann (2000). For an exception to this approach, see Courchene and Harris (1999), who are skeptical about the equation.

The Canadian Dollar's Performance in Perspective

Canada's geographic location next door to the United States and the dominance of trade and capital market transactions with that country over Canada's international economic relations make bilateral comparisons between the two countries both natural and meaningful. While the Canadian dollar's price in US currency is an important variable, not every movement in that price has a Canadian source. Sometimes, the US dollar appreciates for reasons originating in the United States or elsewhere in the world.

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Some sense of perspective can be obtained by looking at the exchange rate of the Canadian dollar, not just against the US dollar, but also against the currencies of other countries. Figure 1 shows such a comparison over the past five years with the currencies of the United Kingdom, Germany, Japan (which have some international importance in their own right), as well as Australia and New Zealand (which, like Canada, are important commodity exporters).[3] The charts largely speak for themselves: on average, the Canadian dollar has appreciated against the deutschmark, the Australian and New Zealand dollars, and even the yen (though only marginally). But it would be hard to argue that these trends reflect any clearly observable superiority in Canada's economic performance over the period nor would anyone seriously argue that the strength of the yen since mid-1998 suggests that the Japanese economy has been flourishing over the past couple of years.

The Canadian dollar's decline against the US dollar is evident enough. With the exception of the yen, however, depreciation against the US dollar has been an even bigger problem — if problem it is — for the other countries shown in Figure 1. This suggests strongly that the main story in foreign exchange markets since 1995 has been the behavior of the US currency relative to those of other countries, with the bilateral Canadian/US dollar rate providing something of a sideshow. Nevertheless, the Canadian dollar's decline still needs to be explained, a task to which we now turn.

The Bank of Canada Exchange Rate Equation

In the early 1990s, Robert Amano and Simon van Norden, two Bank of Canada researchers, developed an equation that seemed to account for the behavior of the Canadian/US dollar exchange rate over the previous 20 years (Amano and van Norden 1993). From the outset, their equation was remarkable for its simplicity and, with the passage of time, it has become even more remarkable for its durability. With only small changes in the definitions of its variables, the equation has survived the addition of data from the 1990s in a form much the same as that in which Amano and van Norden first fitted it.[4] In applied econometrics, things like that do not often happen.

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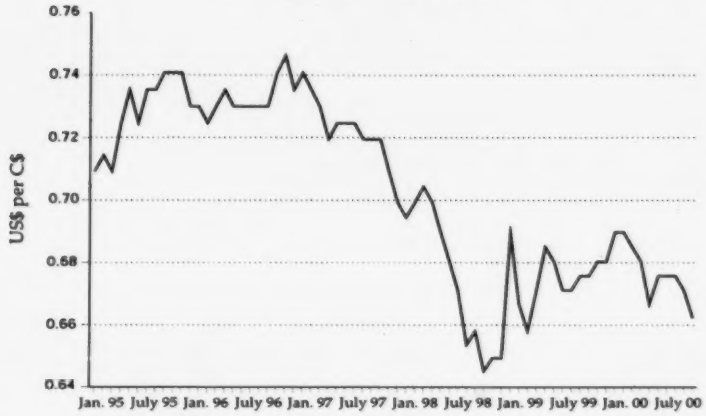
3 Note that, after January 1999, the deutschmark was replaced as Germany's currency by the newly introduced euro.

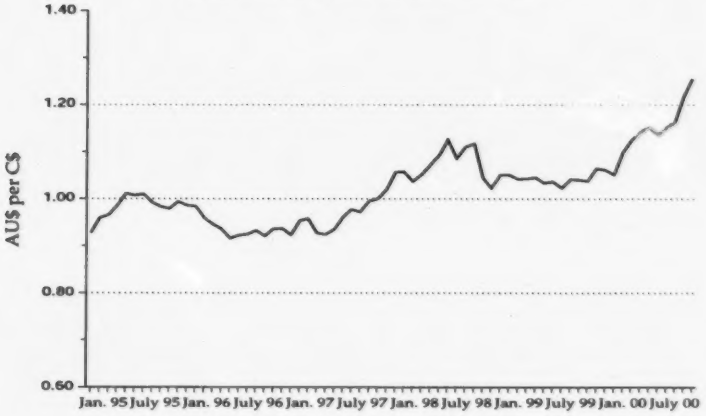
4 See the appendix to this *Backgrounder* for the algebraic form of the equation, as well as a description of some of the recent work we have done with it.

Figure 1: ***The Canadian Dollar's Value against Other Selected Currencies, 1995–2000***

Panel A: Value against the US dollar



Panel B: Value against the Australian dollar



Panel C: Value against the Japanese yen

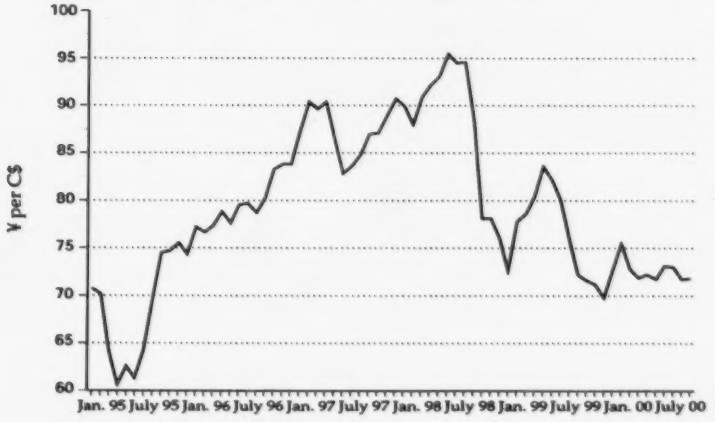
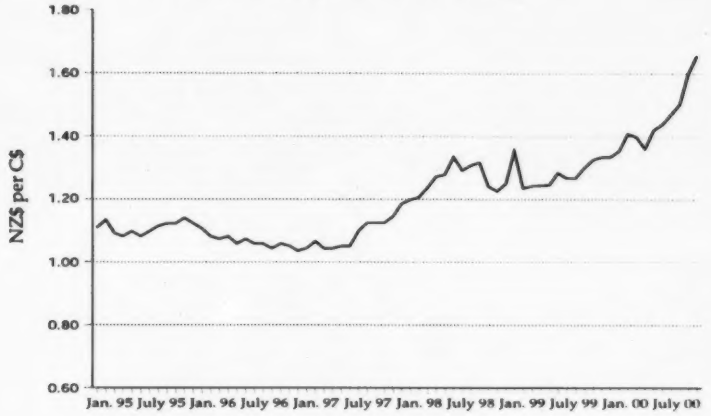
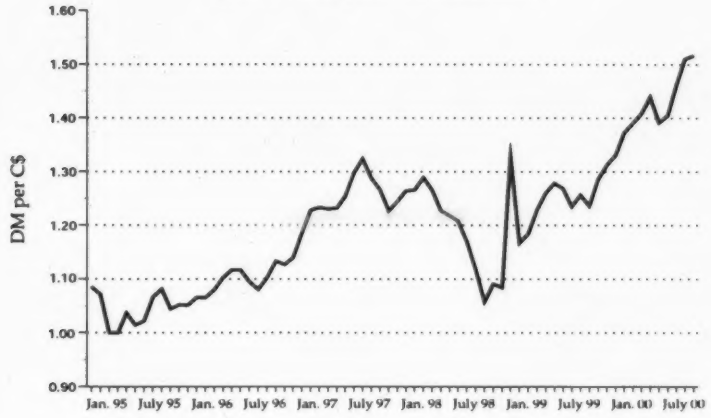


Figure 1 - continued

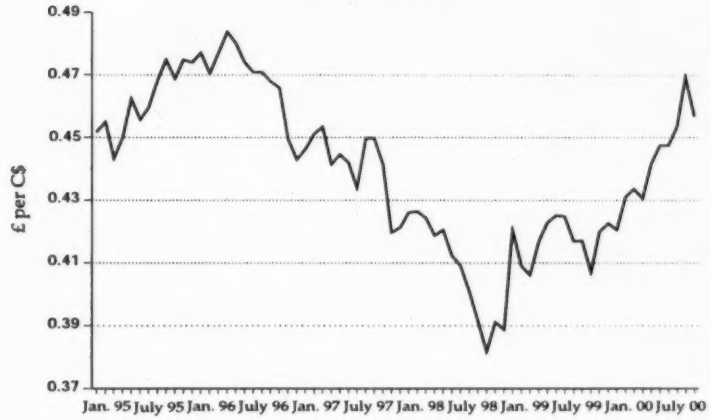
Panel D: Value against the New Zealand dollar



Panel E: Value against the deutschmark



Panel F: Value against the UK pound



The equation's dependent variable is the *real* exchange rate between the Canadian and US dollars — that is, the price of a representative bundle of Canadian goods and services in terms of its US counterpart.[5] It is helpful to divide the equation's explanatory variables into two sets: those that determine the real exchange rate's *long-run* time path and those that account for *shorter-run* fluctuations about that path.

For the long run, our version of the basic equation relies on only two variables: the US dollar price of a representative bundle of non-energy commodities exported by Canada relative to the price of US output (measured by the US GDP deflator), and the price of energy products (again relative to the US GDP deflator).[6] In all previous work that we are aware of with this equation, the first of these terms, whatever its precise formulation, has had a well-determined positive effect on the exchange rate, so that a rise in non-energy commodity prices causes the Canadian dollar to appreciate and vice versa; the second has equally regularly displayed a negative effect, so that a rise in the price of energy causes the dollar to depreciate and vice versa.

Shorter-run fluctuations in the real exchange rate around its long-term path are accounted for by variations in a representative short-term interest differential between the two countries (in their original version of the equation, Amano and van Norden use the differential in the long-short-term yield spread). The role of unspecified "frictions" is captured by the standard econometric device of including a lagged value of the equation's dependent variable on its right-hand side.

The performance of the Bank of Canada equation is shown in Figure 2, which is based on econometric results described in the appendix. It plots the *nominal* exchange rate's actual behavior since 1973 and two sets of predictions of it based on a version of the equation fitted to data to the end of 1994. In both cases, the nominal exchange rate prediction is obtained by adjusting the forecast value of the real exchange rate by the ratio of US to Canadian price levels.

The decline in the Canadian dollar could have been predicted on the basis of an equation that has been in the public domain since 1992.

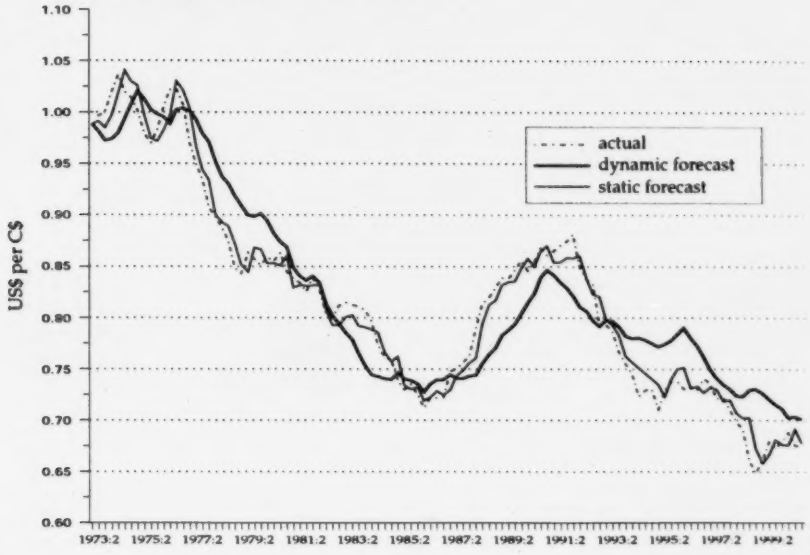
Note first that the equation tracks the exchange rate's downward trend since the 1970s and its large swings about that trend. Particularly striking is that the rate of depreciation picks up after 1995, *even though the equation was estimated using only data available to the end of 1994*. It is this recent decline that has prompted much of the current debate about the "poor" performance of the Canadian dollar. Our results show, however, that this decline could have been predicted on the basis of an equation that has been in the public domain since 1992, fitted to data generally available before 1995.

The first of the two real exchange rate forecasts plotted in Figure 2 comes from a *static* simulation in which predicted values are obtained by substituting actual values of the equation's independent variables into it each quarter and then solving for its dependent variable. The second forecast comes from a

5 In our work, we use gross domestic product (GDP) — the value added within the country's borders — as the specific bundle of goods and services.

6 In contrast, Amano and van Norden deflate commodity prices by the price of Canadian imports, while other versions of the equation use a price index of US manufactured goods. Some versions also use oil prices rather than an index for the price of energy products.

Figure 2: ***Dynamic and Static Simulations for the Canadian Dollar, 1973–2000***



dynamic simulation in which the previously predicted value of the lagged dependent variable, rather than the one actually realized, is entered on the right-hand side. Obviously, this dynamic simulation leaves more scope for things to go wrong and, hence, provides a more stringent test of the equation.

The Role of Commodity Prices in the Canadian Dollar's Behavior

Even though the Bank of Canada equation continues to perform reasonably well almost a decade after its first appearance, it still raises some questions.[7] As Amano and van Norden (1993) themselves note, the key to the equation's success is its division of commodity prices into energy and non-energy components and they did not initially expect the perverse (at first sight) coefficient on the first of these components. After the event, this result was explained by the suggestion that the adverse effects of higher oil prices on the competitiveness of Canada's relatively energy-intensive manufacturing exports outweigh the direct benefits that come from oil exports themselves. Though one of the present authors has accepted this line of argument in the past (see Laidler 1999), it does contain an element of *ex post* rationalization that ought to create a little unease — and prompt some further work into the bargain.

7 Since its first appearance, researchers have tried to add other explanatory variables to it. In particular, the role of government debt and its effects on confidence in the currency has been much investigated, but such effects have proved to be hard to pin down until very recently. See, for example, McCallum (1998) and Murray, Zelmar, and Antia (1999), both of which find that Canada's public-debt-to-GDP ratio has had a negative effect on the exchange rate.

It is a little puzzling that an equation that relies so heavily on commodity prices seems to perform as well in the 1990s as it did in the 1970s.

Moreover, although Canada is still an important commodity exporter, the current fraction of such items in exports (about 30 percent) is a great deal lower than the 1970s' average of 55 percent. It is thus a little puzzling that an equation that relies so heavily on commodity prices and that simply attaches a constant coefficient to them seems to perform as well in the 1990s as it did in the 1970s. This matter, too, is worth a closer look.[8]

Our investigation of the latter question casts some light on the former issue as well. Specifically, we re-estimated the Bank of Canada equation, not with a single coefficient on commodity prices and another on energy prices for the entire 1973–2000 period, but with three separate coefficients on each variable for the 1970s, 1980s, and 1990s, respectively. We find that the sensitivity of the exchange rate to commodity prices does indeed seem to decline from decade to decade, as we expected. Importantly, however, it remained statistically well-determined for each decade, although at a lower level of significance after 1990. However, we also find that energy prices seem to play essentially no role at all in the equation after 1990. Indeed, the coefficient changes sign in the 1990s, albeit not to a statistically significant extent.[9]

This second result is troubling. If the initial presence of energy prices in the equation did reflect some genuine feature of the Canadian economy's structure, along lines discussed above, it should have retained its importance over the past ten years. After all, Canadian manufacturing remains energy intensive, although Canada's role as an exporter of energy resources has grown, which would have tended to push our results in the direction they have, in fact, taken. Even so, it may be that the earlier result was a statistical artifact, and that the explanation previously offered of it was indeed nothing more than an *ex post* rationalization.

John Helliwell (2000) offers an alternative explanation of the apparent earlier importance of energy prices, as well as their perverse sign. He notes that, especially in the 1970s and 1980s, large rises in oil prices coincided with upheavals in the international financial system. These upheavals involved "flight-to-quality"-induced appreciations of the US dollar, the effects of which the Bank of Canada equation picked up but inappropriately attributed to oil prices themselves. In the light of our own results, we believe that this

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8 As our colleague Bill Robson suggested at an early stage of our work. However, two other reviewers, Jack Carr and John Murray, both suggested that the shrinking fraction of commodities in total exports might give a misleading impression of their declining importance. Certainly, this decline has been due the rapid growth of manufactured exports, and these have a large component of imports as inputs. Commodity exports have held steady at about 11 percent of GDP throughout the three decades of our sample.

9 As seen in the appendix, using the consumer price index, rather than the GDP deflator, yields different results: the coefficients on non-energy commodities and on energy prices both lose their statistical significance during the 1990s. However, we tried a much larger number of variations on the equation than we report here, and this was the only case in which commodity prices lose their significance, so we regard their presence in the equation as robust. Energy prices are a different matter: once data for the 1990s are used, their role in the equation is frequently fragile.

explanation should be taken seriously. Things do seem to have changed in the 1990s after all.[10]

Finally, however, we should stress that our econometric results leave the hard core of the Bank equation as firmly established as ever. Its good performance has always been based on its separate treatment of non-energy and energy commodity prices and the robust relationship between the former and the exchange rate. In our work, this effect continues to dominate. Non-energy commodity prices explain, not just the Canadian dollar's long, slow, real depreciation since the 1970s, but also its further slide since 1995. That is to say, the Canadian dollar still seems to be a commodity currency. And, as we point out in the appendix, the role of non-energy commodity prices in the equation is robust in the face of a number of variations on it that we do not discuss in detail here (but see note 9 above for an exception).

Non-energy commodity prices explain, not just the Canadian dollar's long, slow, real depreciation since the 1970s, but also its further slide since 1995.

The fact that the quantitative role of non-energy commodity prices seems to have diminished over time is consistent with what we know about the declining importance of commodities in Canada's international trade (but see note 8). If anything, therefore, this result makes the equation's story still more plausible. Moreover, simulations of our decade-by-decade version of the equation, portrayed in Figure 3, show that it fits the data better than the original formulation.[11]

Our results also enable us to discuss the Canadian dollar's depreciation since the early 1990s, when the difference in Canadian and US inflation rates alone ought to have brought about an *appreciation*. In particular, they warn us that the Bank of Canada equation does not attribute the whole of that depreciation to the behavior of commodity prices, as some commentators have suggested in the past as a preliminary step to their rejecting the equation as implausible (see, for example, Orr 1999 or Courchene and Harris 1999). Figure 3 suggests that the exchange rate was significantly above its predicted value over the period from 1991:Q2 to 1992:Q3, while the interest rate differential was, on average, 2.6 percent in Canada's favor during that time. Had there been no difference in interest rates in the two countries, the predicted value of the exchange rate in our version of the equation should have varied around an average value of approximately 78 US cents over the period. It is the much smaller decline from this value to the 65-to-67 cents range that the equation explains by commodity prices, not its actual decline from the high 80s range.

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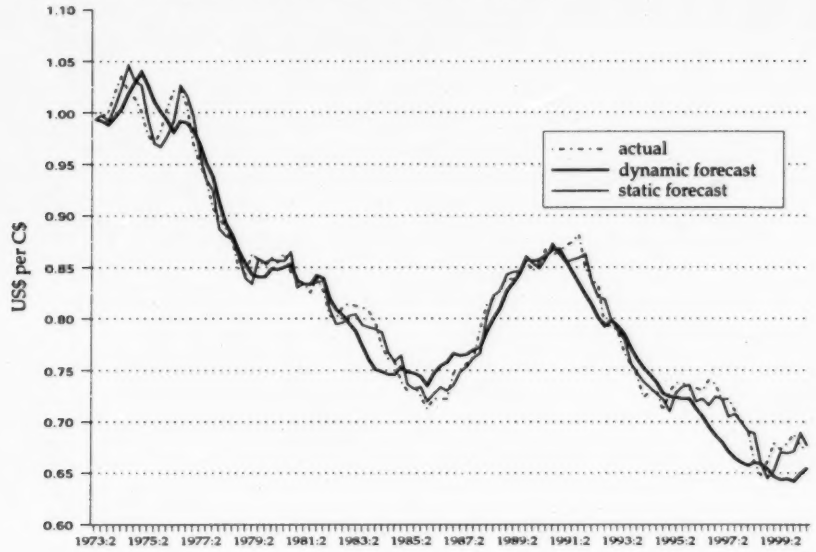
10 We caution, however, against presuming that any single factor is capable of explaining the behavior of the energy price term in the Bank's equation. When econometric results turn out to be fragile, it is often because the variable giving trouble is picking up different effects at different times. Work currently under way at the Bank, to which John Murray has generously drawn our attention, seems to show that adding the US dollar's real exchange rate against currencies other than the Canadian dollar to the Bank's basic equation strengthens the role of energy prices therein. This suggests that the latter variable might have been picking up some flight-to-quality effects, but once these are allowed for, a separate role remains for energy prices in determining the Canadian exchange rate. Here is a case where the adage, "further research is required," surely applies.

11 As shown in Table A-2, the adjusted R^2 rises from 0.276 to 0.380.

Figure 3: ***Dynamic and Static Simulations for the Canadian Dollar, Decade-by-Decade Coefficients, 1973–2000***



It is also worth noting that the predicted value of the exchange rate in 2000:3Q, the last date for which predictions are possible with available data, is 67.7 US cents from the static simulation and 65.5 cents from its dynamic counterpart. The Canadian dollar's recent performance seems to be well accounted for by our version of the Bank of Canada equation. The fact is that non-energy commodity prices reached their peak in 1995:Q4 and have not fully recovered since. Indeed, they lost ground again in 2000:Q3, as reflected in the recent performance of the exchange rate. What is surprising, in the light of our results, is not the exchange rate's recent tendency to be in the 65-to-67 cents range, but the extent of its temporary increase above this range in 1999.

Prospects and Policy Implications

Our results have implications both for the exchange rate's likely behavior in the near future and for the ongoing debate about the place of the exchange rate regime in Canada's monetary order. Our equation singles out three factors as systematically affecting the Canadian dollar's nominal exchange rate: the Canadian-US inflation differential, the interest rate differential ruling between the two currencies, and the time path of non-energy commodity prices in world markets.

The current prospects for the first two factors point in the direction of a modest appreciation of the Canadian dollar: inflation in Canada is still below that in the United States, and it would be inappropriate for the Bank of Canada to fully match recent interest rate cuts by the US Federal Reserve over the next few months. Indeed, purely domestic indicators suggest that, if anything, a

modest tightening of Canadian policy might be in order: not only is consumer price index (CPI) inflation giving some cause for concern, but the effects of the tax cuts that were promised in the pre-election minibudget will require continuing monetary restraint to offset their expansionary effects (see Laidler and Aba 2000). Only a significant weakening of US demand for Canadian manufactured exports in the near future might point to the need for some easing.

The behavior of commodity prices — the third variable affecting the exchange rate — is much harder to forecast. Even if the US economy achieves a soft landing and demand for commodities there remains firm, the key to a recovery in commodity prices will continue to be expansion in Asian economies. And the Japanese locomotive will not begin to gather momentum until that country's central bank engages in aggressive open-market operations and/or unsterilized intervention in the foreign exchange market to ease Japan's chronically tight monetary policy. Such measures do not, however, appear to be on the Japanese agenda. Thus, any appreciation of the Canadian dollar in the near future is likely to be rather modest.

So long as Canada remains a serious commodity exporter, the Canadian dollar will remain a commodity currency.

As to the ongoing policy debate about the exchange rate, the implications of our results are clear. So long as Canada remains a serious commodity exporter, the Canadian dollar will remain a commodity currency. Although this basic fact of life might change in the very long run if the Canadian economy is restructured in a major way toward manufacturing and "new-economy" industries, it must be kept firmly in mind when one discusses history, current events, or medium-term prospects. Non-energy commodity prices have driven down Canada's real exchange rate over the past 30 years, and a fixed nominal exchange rate would not have negated the effects of this variable in the past nor would it do so in the future.

In our view, the most important element in the case for Canada's maintaining a flexible exchange rate is that such a regime permits those who make monetary policy in this country to be held politically accountable to the electorate. Further, our results imply that, under present arrangements, the exchange rate conveys the message that variations in commodity prices affect Canadians' standard of living, and it also helps to bring about the necessary adjustments. Were those arrangements changed, the same message would be transmitted by other means, and it would still require a response.

If the nominal exchange rate were not allowed to depreciate to absorb the effects of falling real commodity prices, domestic wages and prices would have to fall instead — which many would agree is a painful adjustment. Advocates of any kind of fixed exchange rate regime for Canada must, therefore, explain why they disagree with this proposition, or indicate the benefits of such a regime that would make enduring such painful costs worthwhile. And in making their case, they must address the still-growing literature on the determinants of Canada's real exchange rate generated by the Bank of Canada equation.

Appendix: An Econometric Analysis of the Bank of Canada Equation

The original exchange rate equation devised by Amano and van Norden (1993) can be written as follows:

$$\Delta RFX = \alpha(RFX_{t-1} - \beta_0 - \beta_c COM_{t-1} - \beta_e ENE_{t-1}) + \gamma RDIFF_{t-1}.$$

In their original study, ΔRFX is the change in the real exchange rate from one quarter to the other, RFX_{t-1} is last quarter's level of the real exchange rate, COM_{t-1} is last quarter's non-energy commodities terms of trade, and ENE_{t-1} is last quarter's energy terms of trade. The authors calculated $RDIFF_{t-1}$ as the difference between the short-term and long-term interest rate spreads in Canada and the United States, and they expressed all variables, except RDIFF, in natural logarithms. They then converted from a nominal to a real exchange rate by multiplying the price of one Canadian dollar by the ratio of the Canadian CPI to that of the United States.

With a bit of algebra, it is possible to identify the coefficients of this equation using ordinary least squares (OLS). Opening the brackets, we get:

$$\Delta RFX = \alpha RFX_{t-1} - \alpha\beta_0 - \alpha\beta_c COM_{t-1} - \alpha\beta_e ENE_{t-1} + \gamma RDIFF_{t-1}.$$

If we define $-\alpha\beta_0 = \Omega_0$, $-\alpha\beta_c = \Omega_c$, and $-\alpha\beta_e = \Omega_e$, the following equation can be estimated using OLS:

$$\Delta RFX = \Omega_0 + \alpha RFX_{t-1} + \Omega_c COM_{t-1} + \Omega_e ENE_{t-1} + \gamma RDIFF_{t-1}.$$

In the original formulation of this equation, the terms-of-trade variables were measured by the price of a representative bundle of non-energy commodities exported by Canada relative to the price of selected items in Canada's imports (COM), and the price of energy products again relative to that of selected items in Canada's imports (ENE). The Bank of Canada's most recent version defines the variables a bit differently: COM and ENE are now the Bank's commodities price index, broken into its non-energy and energy components, divided by US CPI, and RDIFF is simply the difference between the short-term yield on commercial paper in Canada and the United States.

We adopt all these changes, and add one of our own. In our main equation, the GDP deflator replaces the CPI both to convert from a nominal to a real exchange rate and in the calculation of COM and ENE. We do this because we think that it is more appropriate, when trying to approximate terms-of-trade variables, to use the price of a bundle of goods and services produced in the United States than the price of a bundle of goods and services consumed there, since some of those goods and services are, after all, produced in Canada, among other places. We also believe that this procedure is closer in spirit to the original work of Amano and van Norden. According to previous work done at the Bank of Canada (see Djoudad et al. 2000), nothing of substance hinges on this choice. However, our own work indicates that important differences can sometimes arise from it, particularly when we use data for recent years, with

the GDP deflator yielding the more *a priori* reasonable estimates. Results derived using both approaches are presented below, so that readers may form their own conclusions about this matter.[12]

The share of commodities in Canada's exports has been declining for several decades — from an average of 55 percent in the 1970s to 47 percent in the 1980s to 37 percent in the 1990s.[13] In light of these facts, there is no reason to believe that the effect of commodity prices on the real exchange rate remained stable throughout the past three decades. Rather, one would have expected it to fall in quantitative significance. To test this conjecture, we introduced a separate variable for COM_{t-1} and ENE_{t-1} in every decade. So, for example, the variable COM_{t-1}, 70s takes the same value as COM_{t-1} during the 1970s and a value of zero during the rest of the period, COM_{t-1}, 80s is equal to zero in the 1970s and 1990s, but takes the value of COM_{t-1} in the 1980s, and so on.

The results of these regression are shown in Table A-1. We see that, when the CPI is used, the coefficients on both COM_{t-1} and ENE_{t-1} become statistically insignificant during the 1990s. In contrast, when the GDP deflator is used, the coefficient on COM_{t-1} remains significant and declines every decade. This is consistent with the declining importance of commodities in Canada's exports. The coefficient on ENE_{t-1} remains insignificant during the 1990s.

Next, we present the regression results for the models used in the simulations shown in Figures 2 and 3. It is common practice to run the regressions using a sample that does not include a predetermined forecast period. Hence, our regressions use data covering the period from 1973:Q1 to 1994:Q4; the results are shown in Table A-2.[14]

The equation that forces the coefficients on COM_{t-1} and ENE_{t-1} to be constant during the sample period does not fit as well as the one that allows them to change every decade, even when adjusted for degrees of freedom. This is suggested by a comparison of Figures 2 and 3, and is established by comparing the adjusted R^2 shown in Table A-2. We also see the decline of the coefficient on COM_{t-1} as we go forward in time, reflecting the effect of the decreasing share of commodities in Canada's exports. Finally, Table A-2 shows that the coefficient on ENE_{t-1} changes sign and loses statistical significance during the 1990s. This points to a possible parameter instability for ENE_{t-1}. While a complete econometric analysis that addresses this question of instability is well beyond the scope of this *Backgrounder*, we did compare forecasts from a model that includes ENE_{t-1} with those from a model that does not include it. Both models use data covering the period from 1973:Q2 to 1989:Q4, and provide 43 *ex post* forecasts covering the period from 1990:Q1 to

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12 In our work, we do not carry out the standard cointegration tests, but Bank of Canada studies estimating this equation have found that cointegration is present.

13 When calculating these figures, we included only those items that comprise the Bank of Canada's commodity price index.

14 The coefficient on COM_{t-1}, 90s is not statistically significant according to conventionally accepted levels. This is clearly due to the small number of observations. Table A-1 shows that, with more observations, COM_{t-1}, 90s is statistically significant.

Table A-1: *Regression Results for the Value of the Canadian Dollar Using the CPI and the GDP Deflator*

	Using the CPI		Long Run		Using the GDP Deflator		Long Run	
	Coefficient	t-probability	Coefficient	t-probability	Coefficient	t-probability	Coefficient	t-probability
	Equation (1)				*Equation (2)*			
Constant	–0.091		–0.829	0.000	–0.152		–1.015	0.000
RFX_{t-1}	–0.111	0.000			–0.151	0.000		
COM_{t-1}	0.045		0.405	0.000	0.075		0.500	0.000
ENE_{t-1}	–0.010		–0.089	0.031	–0.012		–0.082	0.205
$RDIFF_{t-1}$	0.251	0.000			0.272	0.000		
$R^2 = 0.19$ Adjusted $R^2 = 0.16$ DW = 1.39					$R^2 = 0.24$ Adjusted $R^2 = 0.22$ DW = 1.29			
	Equation (3)				*Equation (4)*			
Constant	–0.086		–0.606	0.004	–0.162		–0.969	0.000
RFX_{t-1}	–0.130	0.000			–0.170	0.000		
COM_{t-1}, 70s	0.066		0.496	0.000	0.101		0.600	0.000
COM_{t-1}, 80s	0.054		0.396	0.001	0.092		0.554	0.000
COM_{t-1}, 90s	0.014		0.095	0.583	0.051		0.338	0.045
ENE_{t-1}, 70s	–0.038		–0.303	0.003	–0.038		–0.226	0.006
ENE_{t-1}, 80s	–0.022		–0.174	0.007	–0.025		–0.150	0.007
ENE_{t-1}, 90s	0.017		0.125	0.446	0.017		0.065	0.663
$RDIFF_{t-1}$	0.290	0.000			0.304	0.000		
$R^2 = 0.34$ Adjusted $R^2 = 0.29$ DW = 1.61					$R^2 = 0.38$ Adjusted $R^2 = 0.33$ DW = 1.50			

Note: All variables except RDIFF are expressed in logarithms; data are for the period 1973:Q1–2000:Q3.

Table A-2: *Equations Used in Forecasts of the Value of the Canadian Dollar Presented in Figures 2 and 3*

			Long Run	
	Coefficient	t-probability	Coefficient	t-probability
	Equation Used for Forecasts in Figure 2			
Constant	–0.145		–0.863	0.000
RFX_{t-1}	–0.168	0.000		
COM_{t-1}	0.074		0.442	0.000
ENE_{t-1}	–0.016		–0.095	0.003
$RDIFF_{t-1}$	0.260	0.000		
$R^2 = 0.28$ Adjusted $R^2 = 0.28$ DW = 1.15				
	Equation Used for Forecasts in Figure 3			
Constant	–0.144		–0.963	0.000
RFX_{t-1}	–0.151	0.000		
COM_{t-1}, 70s	0.095		0.638	0.000
COM_{t-1}, 80s	0.084		0.566	0.000
COM_{t-1}, 90s	0.038		0.288	0.189
ENE_{t-1}, 70s	–0.040		–0.272	0.008
ENE_{t-1}, 80s	–0.025		–0.167	0.009
ENE_{t-1}, 90s	0.022		0.107	0.598
$RDIFF_{t-1}$	0.310	0.000		
$R^2 = 0.44$ Adjusted $R^2 = 0.38$ DW = 1.44				

Note: All variables except RDIFF are expressed in logarithms; data are for the period 1973:Q1–1994:Q4.

2000:Q3. In terms of average forecast error, adjusted for the number of independent explanatory variables, the model that excludes ENE_{t-1} does better. Further work on this econometric issue is therefore needed.

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